

## Non-Preference and Antibiosis Components of Resistance in American Cotton to the Leaf Hopper, *Amrasca biguttula biguttula* Ishida\*

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Non-preference and antibiosis components of resistance to the leaf hopper, *Amrasca biguttula biguttula* Ishida were studied in cotton HB 69 (Resistant), GS 23 (tolerant) in relation to the susceptible variety PRS 72. The results indicated the discriminating behaviour of leaf hopper for the cotton varieties for feeding. The variety PRS 72 harboured as high as 30.96 nymphs/plant showing its greater susceptibility while GS 23 and HB 69 were less preferred with 18.88 and 10.32 nymphs/plant respectively indicating their relative resistance. The susceptible PRS 72 and tolerant GS 23 were more preferred for oviposition by recording a population of 27.04 and 17.88 nymphs per plant respectively as against only 10.68 in the case of resistant HB 69. The lower lamina of resistant HB 69 had a high density of hairs (97.80/Sq.cm) than the susceptible PRS 72 (8.11/Sq.cm). Resistant HB 69 showed less fecundity per leaf hopper (9.9 nymphs), long nymphal period (16.48 days) and less percentage of nymphs becoming adults (19.9%) compared to high fecundity (30.2 nymphs) high percentage of nymphs becoming adults (64.1%) and short nymphal period (9.36 days) in the susceptible PRS 72.

Resistance is the relative-phenomenon concerned with the interaction between plants and insects and is expressed in comparison with other plants or varieties which are generally susceptible. Experiments were conducted by the authors to screen the hirsutum cottons for their resistance to the leaf hopper both under field and glass house conditions which revealed the variety HB 69 to be resistant, GS 23 tolerant and PRS 72 to be susceptible. In order to prove the resistance as true and not by "pseudo-resistance" due to host evasion and/

or "escape", pot culture experiments were conducted and studied the non-preference and antibiosis components of resistance to the leaf hopper in the above cotton varieties and the results are presented in this paper.

### MATERIAL AND METHODS

Based on the field trials with 57 varieties and also with the confirmatory trial under glass house conditions, three varieties HB 69, GS 23 and PRS 72 were selected as representative of resistant, tolerant and highly suscepti-

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ble categories. The preference or non-preference and antibiosis mechanism of resistance were studied with the above three varieties.

#### Preference for oviposition:

Fifty adult jassids were released in potted plants and left undisturbed for 72 hours by which time oviposition is completed in jassids as reported by Jayaraj (1968) and Uthamaswamy (1969). Then the adults were removed from the cage and the plants caged separately to observe the hatching of nymphs. The newly hatched nymphs were removed once a day till the hatching was over. The number of nymphs hatched out on each variety was considered as a measure of eggs laid by jassids on that variety. The experiment was replicated five times.

#### Preference for feeding

It was studied in a similar manner by introducing fifty freshly hatched nymphs into the cage. The number of nymphs found feeding on the plants 24 hours after release was considered as having been attacked by the varieties.

#### Antibiosis mechanism of host plants on the leaf hoppers

Leaf hopper cultures were maintained separately on cotton plants and the fecundity rate on different varieties was assessed with several single mating pairs. The leaf hoppers were collected and released into each plastic cage and a leaf lobe was inserted into the cage. The leaf hoppers were allowed to feed and oviposit on the same leaf lobe for 8 days within

which period the oviposition was completed. The nymphs that hatched out from each lobe was counted, and removed once a day. The progressive total of daily hatch was recorded separately for each variety. This experiment was replicated five times.

The percentage of nymphs becoming adults in respect of each of the three varieties was estimated by rearing newly hatched nymphs in batches of five in each plastic cage. The nymphal period was observed by allowing first instar nymphs to feed on the healthy plants of the three varieties and caging them with micro cages. The adult longevity was studied by collecting and caging individual adult leaf hopper on single leaf lobes of the plants.

#### Density of leaf hairs:

The hairs on the under and upper surfaces of the lamina were determined by counting the total number of hairs per square centimetre area of fifth leaf from the top. (Singh *et al.* 1972). The total number of hairs in one cm length on the upper and lower mid rib was counted from the same leaf. Length of hairs was measured from the lower mid rib.

### RESULTS AND DISCUSSION

#### i) Preference of the leaf hopper to the host varieties.

a) Preference for feeding and oviposition: the discriminating behaviour of jassids for the cotton varieties for feeding and oviposition was noted. The variety PRS 72 harboured as high as 30.96 nymphs showing its greater sus-

ceptibility to the leaf hopper infestation. The varieties GS 23 and HB 69 were less preferred with 18.88 and 10.32 nymphs per plant respectively indicating their relative resistance (Table I). The susceptible variety had a two hundred per cent increase in the nymphal population over the resistant variety. The susceptible and tolerant varieties recorded a population of 27.04 and 17.88 nymphs per plant respectively as against only 10.68 in resistant HB 69 variety indicating the preference of the former two varieties for oviposition. (Table I). Several workers reported that susceptible varieties of cotton (Verma and Afzal, 1940 and Krishnananda, 1973) and castor (Jayaraj 1968) are highly preferred by the leaf hoppers.

## ii) Antibiosis Mechanism of resistance in cotton

The data on the nymphal period, percentage of nymphs becoming adults

TABLE I. Preference of cotton varieties for feeding and oviposition by the leaf hopper (under glass house conditions)

Variety	Number of nymphs observed on each plant for feeding*	Percentage increase over HB 69	Number of nymphs hatched out per plant	Percentage increase over HB 69
PRS 72 (Susceptible)	30.96	200.0	27.04	153.1
GS23 (Tolerant)	18.88	82.9	17.88	67.4
HB69 (Resistant)	10.32	—	10.68	—

\* Mean of five observations

Comparison of significant effects	Levels of significance	Levels of significance
Between varieties	(P=0.01)	(P=0.01)
S.E.	0.65	0.50
C.D.(P=0.05)	1.86**	1.43**

\*\* Significant at 1% level

TABLE II. Antibiosis tests - effect of cotton varieties on the fecundity, nymphal period and percentage of nymphs becoming adults (under glass house conditions - Mean of five observations)

Variety	Fecundity per jessid	Percentage of increase from HB 69	Nymphal period in days	Percentage of decrease from HB 69	Percentage of nymphs becoming adults	Percentage of increase over HB 69
PRS 72 (Susceptible)	30.2	205.0	9.36	43.2	64.1 (53.2)	100.7
GS 23 (Tolerant)	20.0	102.0	12.48	24.2	33.1 (35.1)	32.4
HB 69 (Resistant)	9.0	—	16.48	—	19.9 (26.5)	—
S.E.	0.61		0.21		0.72	
C.D. (P=0.05)	1.74**		0.59**		2.04**	

\*\* Significant at 1% level

(Figures in parenthesis are transformational values).

TABLE III. Antibiosis tests - effect of cotton varieties on the longevity of adults in days (under glass house condition - Mean of five observations)

Variety	Adult longevity in days				Mean	Percentage of increase over HB 69
	Male	Percentage of increase over HB 69	Female	Percentage of increase over HB 69		
PRS 72 (Susceptible)	12.87	75.6	16.46	91.3	14.66	84.1
GS 23 (Tolerant)	10.46	42.7	14.06	63.5	12.26	54.0
HB 69 (Resistant)	7.33	—	8.60	—	7.96	—
Mean	10.22	—	13.04	—	—	—
Comparison of significant effects	Levels of significance			SE	CD (P=0.01)	
Between varieties	(P=0.01)			0.23	0.65**	
Between sexes	(P=0.01)			0.18	0.51**	
Interaction between sexes and varieties	(P=0.01)			0.33	0.93**	

\*\* Significant at 1% level

and fecundity revealed that resistant HB 69 had less fecundity per leaf hopper (9.9 nymphs) long nymphal period (16.48 days) and percentage of nymphs becoming adults (19.9) compared to high fecundity (30.2 nymphs), short nymphal period (9.36 days) and high percentage of nymphs becoming adults (64.1) in PRS 72; while the variety G.S. 23 registered a moderate nymphal period (12.48 days), fecundity (20.0 nymphs per leaf hopper) and 33.1 per cent nymphs becoming adults (Table II). The longevity of females was found to be higher in the susceptible PRS 72 when compared to the resistant HB 69 (Table III). In all the three varieties, the females lived for a longer period than the males with a mean period of 13.04 and 7.33 days for female and male respectively. Similarly Jayaraj (1967) reported a decrease in the fecundity, in the percentage of nymphs

becoming adults in adult longevity of *E. flavescens* feeding on the resistant castor variety. Similar influence due to unfavourable host of *E. fabae* has also been reported by Poos and Smith (1931), Harrington (1941), Dahms and Painter (1940). Carnahan *et al.* (1963) observed a lowered fecundity of the pea aphid on peas and its reproduction was prevented in the resistant alfalfa varieties. Chinch bugs fed on resistant sorghums are also found to exhibit reduced fecundity (Dahms, 1948).

#### Hair density and length of hairs

Hairiness is a complex character involving several factors like the hairiness of stem or leaves, or petioles, the length of hairs, the density of hair cover and the type of hairs. Hairiness interfered with the feeding of nymphs than adults (Parnel *et al.* 1949) and

TABLE-IV. Details of hairiness in resistant, tolerant and susceptible selections

Variety	(Mean of fifteen observations)									
	Density of hairs (No. of hairs/Sq.cm)				Density of hairs (No. of hairs/Sq.m)				No. of hairs in cm.length	
	Upper lamina	Percentage of decrease from HB 69	Lower lamina	Percentage of decrease from HB 69	Upper midrib	Percentage of decrease from HB 69	Lower midrib	Percentage of decrease from HB 69	Lower midrib	Percentage of decrease from HB 69
PRS 72 (Susceptible)	3.66	88.5	8.11	91.70	19.55	75.8	17.4	78.8	0.22	72.5
GS 23 (Tolerant)	31.16	1.60	72.90	25.46	66.40	17.7	70.9	13.9	0.52	35.0
HB 69 (Resistant)	31.67	—	97.80	—	80.67	—	82.2	—	0.80	—
Mean	22.16		59.60		55.54		56.8		0.51	
level of significance	(P=0.01)		(P=0.01)		(P=0.01)		(P=0.01)		(P=0.01)	
S.E.	1.60		2.18		2.08		2.85		0.018	
C.D. (P=0.05)	4.57**		(6.23)**		(5.94)**		(8.14)		(0.050)**	

\*\* Significant at 1% level.

with oviposition (Husain and Lal, 1940). Hairiness at the juncture of the petiole with lamina was found to be more in resistant selections.

The results indicated that lower lamina had higher density of trichomes (59.6) compared to upper lamina (22.16). The lower midrib had a higher number of hairs than the upper midrib. The length of hairs in the lower midrib was maximum in the resistant HB 69 (0.80 mm) followed by 0.52 mm in the tolerant GS 23 and 0.22 mm in the susceptible PRS 72. (Table IV). There are quite a number of evidences to show that resistant cotton varieties are found to contain high density of long trichomes on the under surface of leaves

contributing resistance to hopper (Sikka *et al.* 1966 and Krishnananda, 1973).

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## REFERENCES

- CARNAHAN, H.L., R.N. PEADEN, F.V. LIESERMAN and R.K. PETERSON. 1963. Differential reactions of alfalfa varieties and selections to the pea aphid. *Crop. Sci.* 3:219-22.
- DAHMS, R.G. 1948. Effect of different varieties and ages of sorghum on the Biology of the Chinch bug. *J. agric Res.* 76:271-88.
- DAHMS, R.G. and R.H. PAINTER. 1940. Rate of reproduction of the pea aphids on dif-

- ferent alfalfa plants. *J. econ. Ent.*, 23: 482-85.
- HARRINGTON, C.D. 1941. Influence of aphid resistance in pees upon aphid development, reproduction and longevity. *J. agric. Res.*, 62: 461-66.
- HUSAIN, M. A. and K. B. LAL. 1940. The bionomics of *Empoasca devastans* (Dist.) on some varieties of cotton in Punjab. *Indian J. Ent.*, 2: 123-26.
- JAYARAJ, S. 1967. Antibiosis mechanism of resistance in castor varieties to the leaf hopper, *Empoasca flavescens* (F) (Homoptera: Jassidae) *Indian J. Ent.*, 29: 73-78.
- JAYARAJ, S. 1968. Preference of castor varieties for feeding and oviposition by the leaf hopper, *Empoasca flavescens* (F) (Homoptera: Jassidae) with particular reference to its honey dew secretion. *J. Bombay Nat. His. Soc.* 65: 64-74.
- KRISHNANANDA, N. 1973. Studies on resistance to jassid *Amrasca devastans* (Dist.) (Jassidae: Homoptera) in *Entomologists. Newsl.*, 31: 1-2.
- PARNEL, H.E., KING and E.F. RUSTON. 1949. Jassid resistance and hairiness of the cotton plant. *Bull. Ent. Res.*, 39: 539-75.
- POOS, F.W., and F.F. SMITH. 1931. A Comparison of oviposition and nymphal development of *Empoasca fabae* (Harr.) on different host plants. *J. econ. Ent.*, 24: 361-71.
- SIKKA, S. M., V. M. SAHNI and D. K. BU'ANI. 1966. Studies on jassid resistance in relation to hairiness of cotton leaves. *Eunhytica*, 15: 383-88.
- SINGH, T.H., K. P. GURDIP SINGH, SHAIMA and S. P. GUPTA. 1972. Resistance of cotton (*Gossypium hirsutum* L.) to cotton jassid, *Amrasca devastans* (Distant) (Homoptera: Jassidae) *Indian J. agric. Sci.* 42: 421-25.
- UTHAMASAMY, S. 1969. Studies on the varietal resistance of bhendi, (*Abelmoschus esculentus* (L) Moench) to the leaf hopper *Amrasca (Empoasca) devastans* (Dist.) (Homoptera: Jassidae) Unpub. M.Sc. (Ag). Dissert. submitted to Univ. Madras.
- VERMA, P.M. and M. AFZAL. 1940. Studies on the cotton jassid, *Empoasca devastans* (Dist.) in the Punjab. I. Varietal susceptibility and development of the pest on different varieties of cotton. *Indian J. agric. Sci.*, 10: 911-26.